Site Index

The Quest for Measures of Site Condition in a Military Installation Context

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The Problem
(re-stated)

After the research teams involved in this study had been working for almost two years, about when they were reporting on the results of their first full year of results, it became clear that the initial characterization of their study sites into areas of “low,” “moderate,” and “high” disturbance was too imprecise to allow cross-project comparisons of impact.

Our Dilemma

It was not difficult to agree on certain conditions, for example:

This shows evidence of heavy disturbance

The truth is that different teams placed these sites in ALL classes, from low to high!

Now you see a little more of the problem facing SEMP researchers

Problem Defined

- **Ends of the scale are pretty easy**
- **Intermediate classes VERY hard to define**
- **“Spacing” of different classes unclear**
- **Almost all study sites were intermediate!**
- **Working definitions are usually fuzzy, though workable…here, an example from a manuscript:**
  - **High impact sites were characterized by current landscape-scale training activities with mechanized infantry and supporting tactical elements.**
  - **Medium sites had experienced past military activities, but current use was light, consisting mostly of foot traffic confined to existing roads and trails.**
  - **Light sites had no evidence of military activities, but like the others were subjected to agricultural land-use prior to the 1940s.**

Proposed Solution

- **Develop an “index” or measure of quality**
- **Should work across the full range of local landscapes**
- **Ought to utilize actual values rather than subjective classes (insofar as possible)**
- **Should contain elements with clear biological relevance**

Our Advisory Committee Proposed Candidate Elements

(June 2002)

- 1. Vegetation structure (i.e., vertical layer, as well as horizontal distribution) and composition of communities by ecological group (as defined in Fort Benning's INRMP)
- 2. Soil compaction (may correlate with changes in soil horizon profile)
- 3. Microfloral populations (applies to both terrestrial and aquatic systems)
- 4. Plant productivity (applies to both terrestrial and aquatic systems)
- 5. Soil and sediment carbon
- 6. Plant (Raunkier) life form for communities
- 7. Historical land use and current road/trail networks? (both qualitative and quantitative)
- 8. Remotely-sensed surface cover by ecological group

  (Primarily focused on terrestrial applications)

Development Process

(Terrestrial Application)

- Started with advisory committee's suggestions
- Team Leaders reviewed proposed parameters
- TLs asked to propose additional parameters
  - Several were proposed
- Team Leader-Project Manager conference call
- Distributed spreadsheet with potential parameters – now 13 in all, with added candidates
- Team Leaders ranked parameters on 1-5 scale
- Seven ranked at >3.75 appeared highest value

Candidate Parameters

(after we added new elements from research teams)

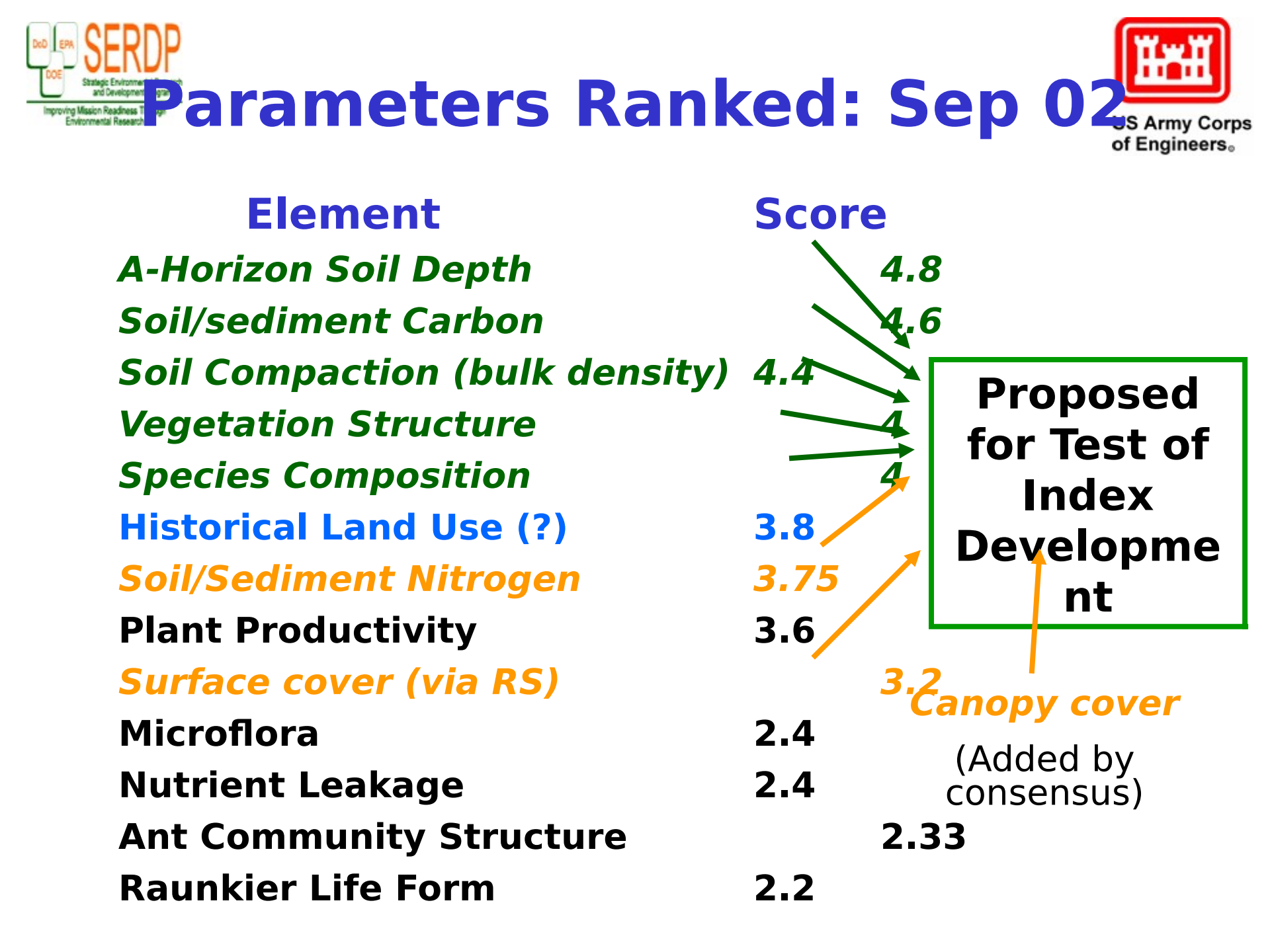
1. Vegetation Structure
2. Soil Compaction (bulk density)
3. Microflora
4. Plant Productivity
5. Soil/sediment Carbon
6. Raunkier Life Form
7. Historical Land Use
8. Surface cover (via RS)
9. A-Horizon Soil Depth
10. Nutrient Leakage
11. Ant Community Structure
12. Species Composition
13. Soil/Sediment Nitrogen

Rank of Elements after TL Inputs

Element	Score
A-Horizon Soil Depth	4.8
Soil/sediment Carbon	4.6
Soil Compaction (bulk density)	4.4
Vegetation Structure	4
Species Composition	4
Historical Land Use	3.8
Soil/Sediment Nitrogen	3.75
Plant Productivity	3.6
Surface cover (via RS)	3.2
Microflora	2.4
Nutrient Leakage	2.4
Ant Community Structure	

Parameters Ranked: Sep 02

Element	Score
A-Horizon Soil Depth	*4.8*
Soil/sediment Carbon	*4.6*
Soil Compaction (bulk density)	*4.4*
Vegetation Structure	*4*
Species Composition	*4*
Historical Land Use (?)	3.8
Soil/Sediment Nitrogen	*3.75*
Plant Productivity	3.6
Surface cover (via RS)	
Microflora	2.4
Nutrient Leakage	2.4
Ant Community Structure	
Raunkier Life Form	2.2



Development of the Index Plan

- First plan was to use only top 5 items
- Soil N was moved up since most analyses provide C/N in single step
- Surface cover moved up, and canopy cover added as simple and relevant
- New full set includes 8 parameters
- Agreed that these were the “easy to use” set, not necessarily the “best” technically

Some Modifications Needed

- **In practice, some elements resisted quantification**
  - **Past land use unavailable on the scale needed**
  - **Military use known only as general patterns, not site-specific on the scale needed**
  - **Present cover so variable that no patterns were evident**
  - **Vegetation structure and species composition not immediately quantifiable in simple terms**
- **Alternative measures used for some things**
  - **Penetrometer substituted for bulk density**

Prescott Tasking

- **Recognized (April 03) that there was significant parallelism between needs for Site Index data and 1114B team's goals**
- **Prescott team agreed to combine the tasks in summer 2003**
- **Several problems with acquisition**
  - **Access restrictions**
  - **Weather**
- **Work 90% complete in August**
  - **Almost all missing elements acquired by Sept 03**
  - **Five missing readings to be acquired Oct 9-10**

First Full Test

April-July 2003

- **Prescott College team tasked to acquire data**
- **Forty sites selected**
  - **Widest possible range of landscapes**
  - **Included ecologically sensitive areas**
  - **Included most-heavily used military areas**
- **Twenty-two sites had been previously studied by SEMP teams**
- **Five parameters to be collected**
  - **A-horizon**
  - **Compaction**
  - **Vegetation (4 elements)**
  - **Soil C and N**

Initial Results (Aug 03)

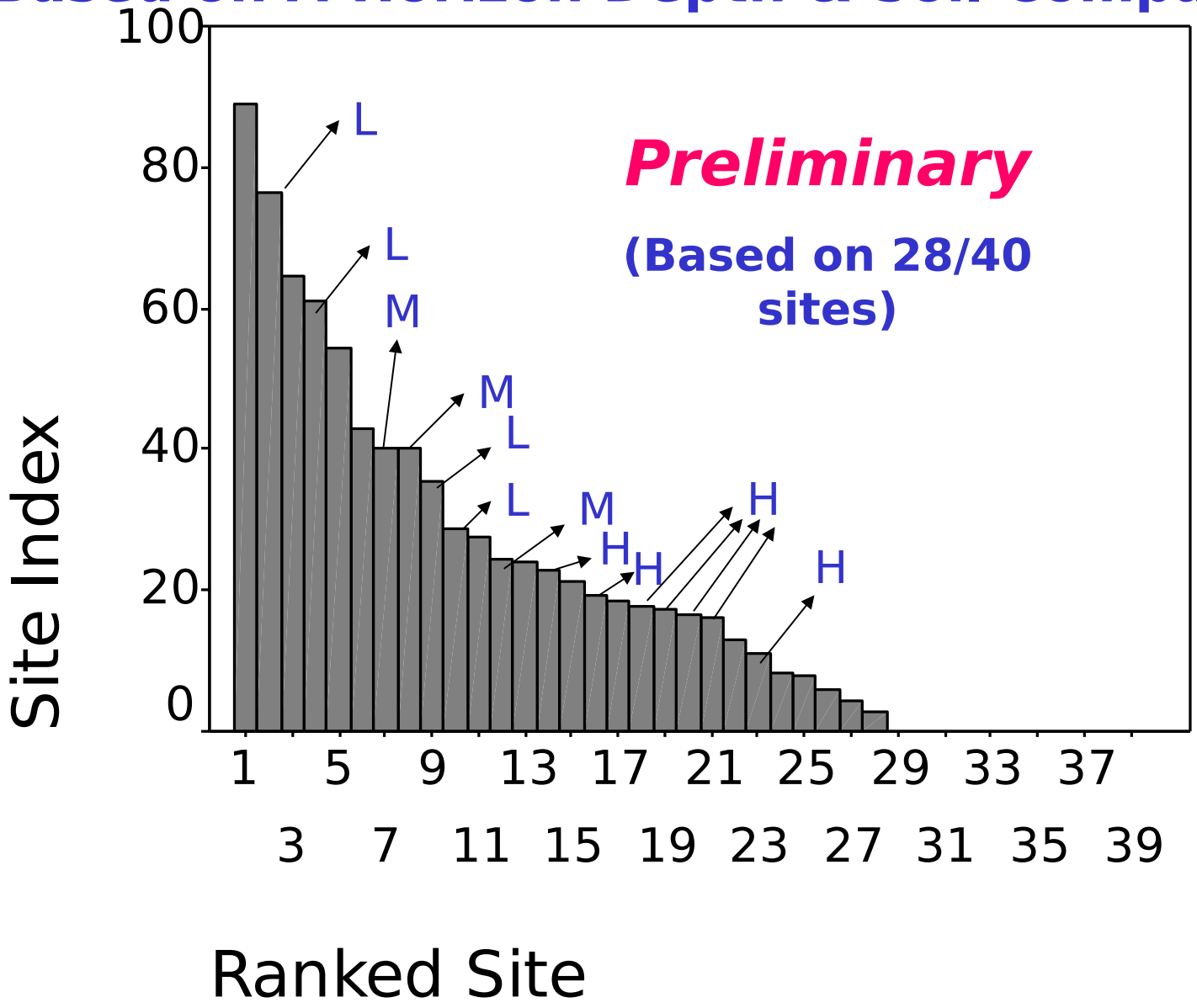
- **Data not quite complete**
  - **Weather prevented some collections**
  - **Military training safety closures prevented others**
  - **Missing elements identified July 03**
  - **Collections scheduled for Aug-Sep 03**
  - **Soil measures require laboratory time**
  - **Planned completion by 30 Sep 03**
- **Preliminary results (Aug 03) included only A-horizon and compaction**

Index Development

- **Ranked from lowest to highest value**
  - **Some values (for A-horizon) were truly zero**
  - **1600 A-horizon values**
  - **8000 penetrometer readings**
- **Ranges were re-scaled so that the mean value for each parameter equaled 100**
  - **Values then divided by two so each range was normalized**
  - **Direction of range adjusted where necessary**
- **Maximum value per element thus = 100**
- **For two elements, add and divide by 2**
- **Maximum possible index thus = 100**

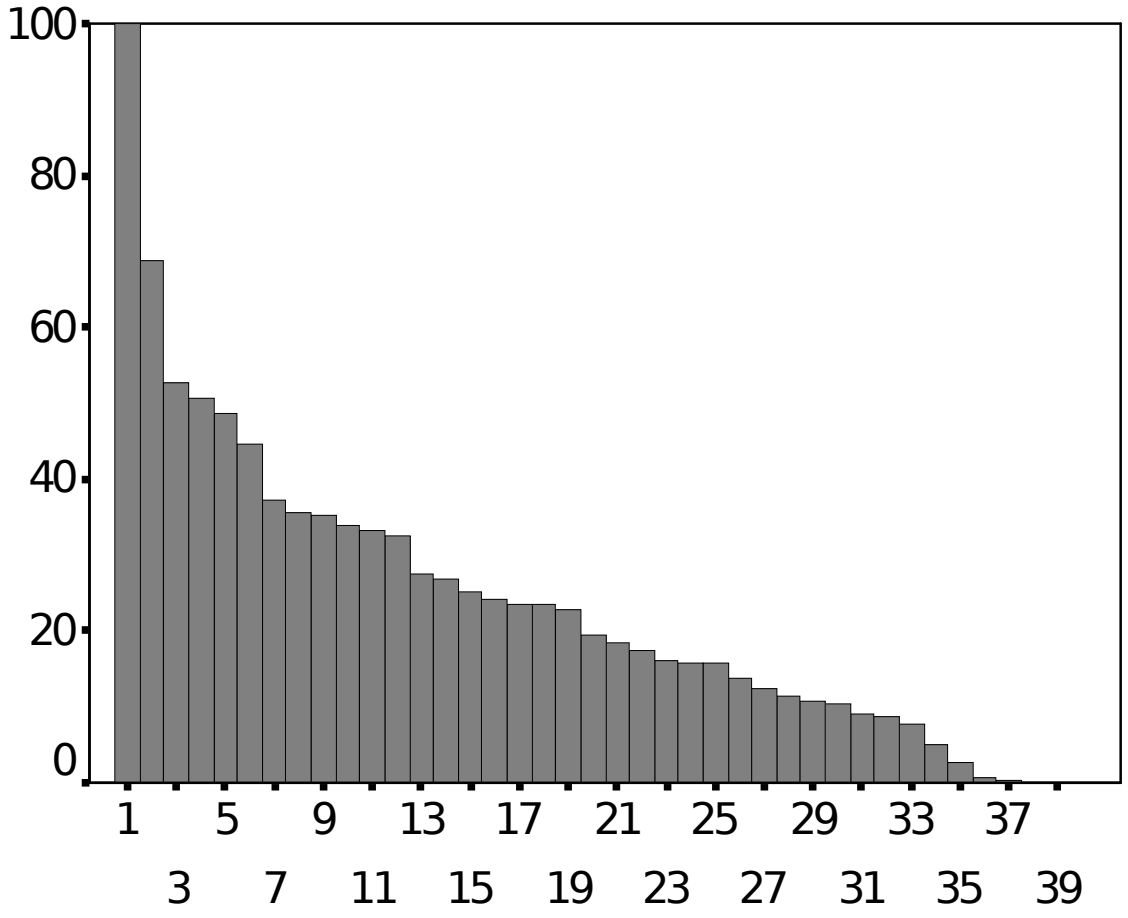
Site Index

Based on A-Horizon Depth & Soil Compaction

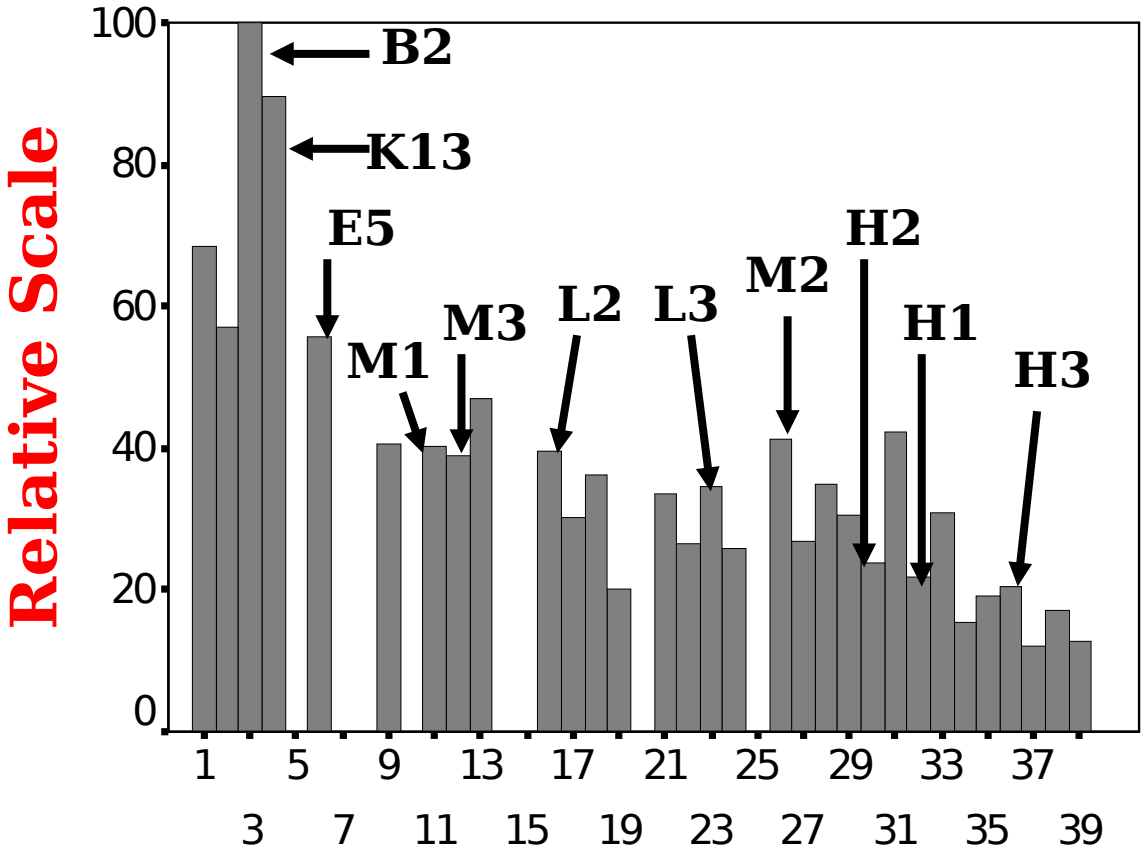


A-horizon Depth

Using 36 of 40 sites

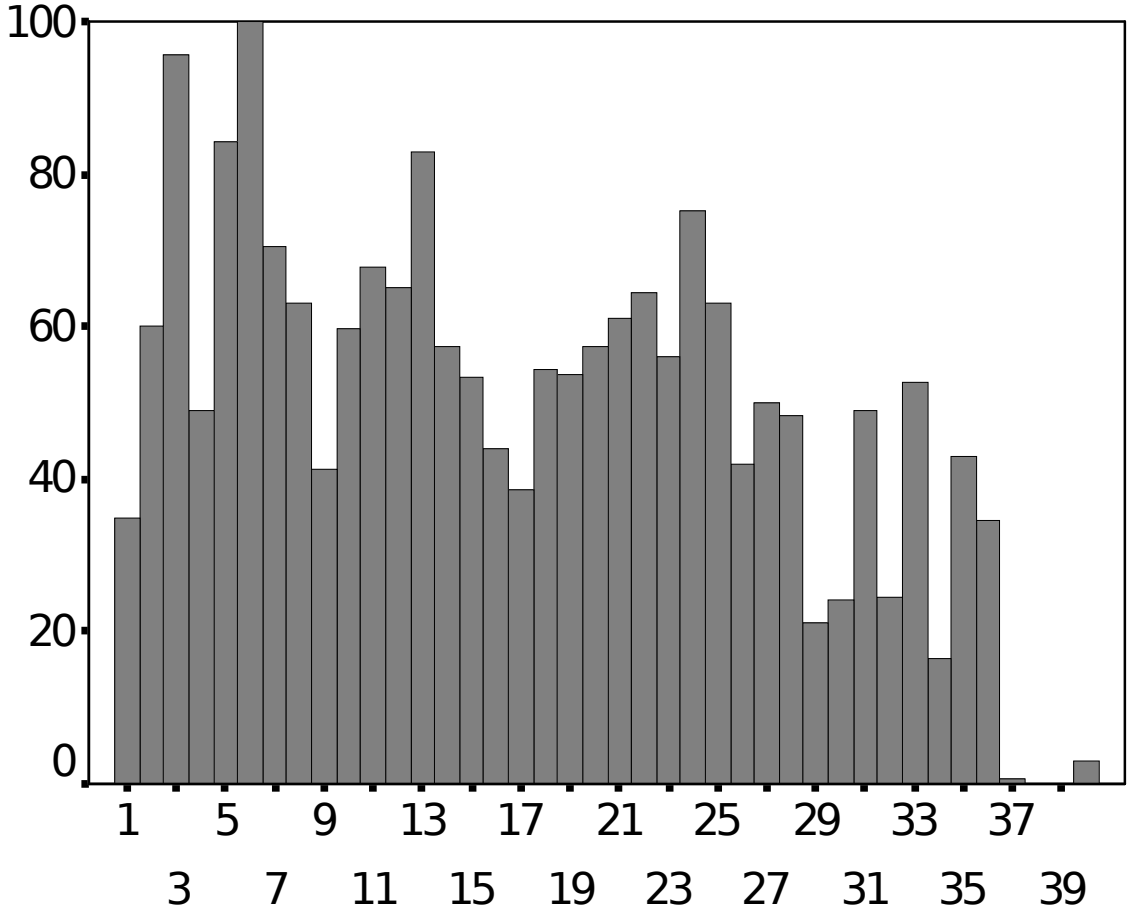


Soil Compaction



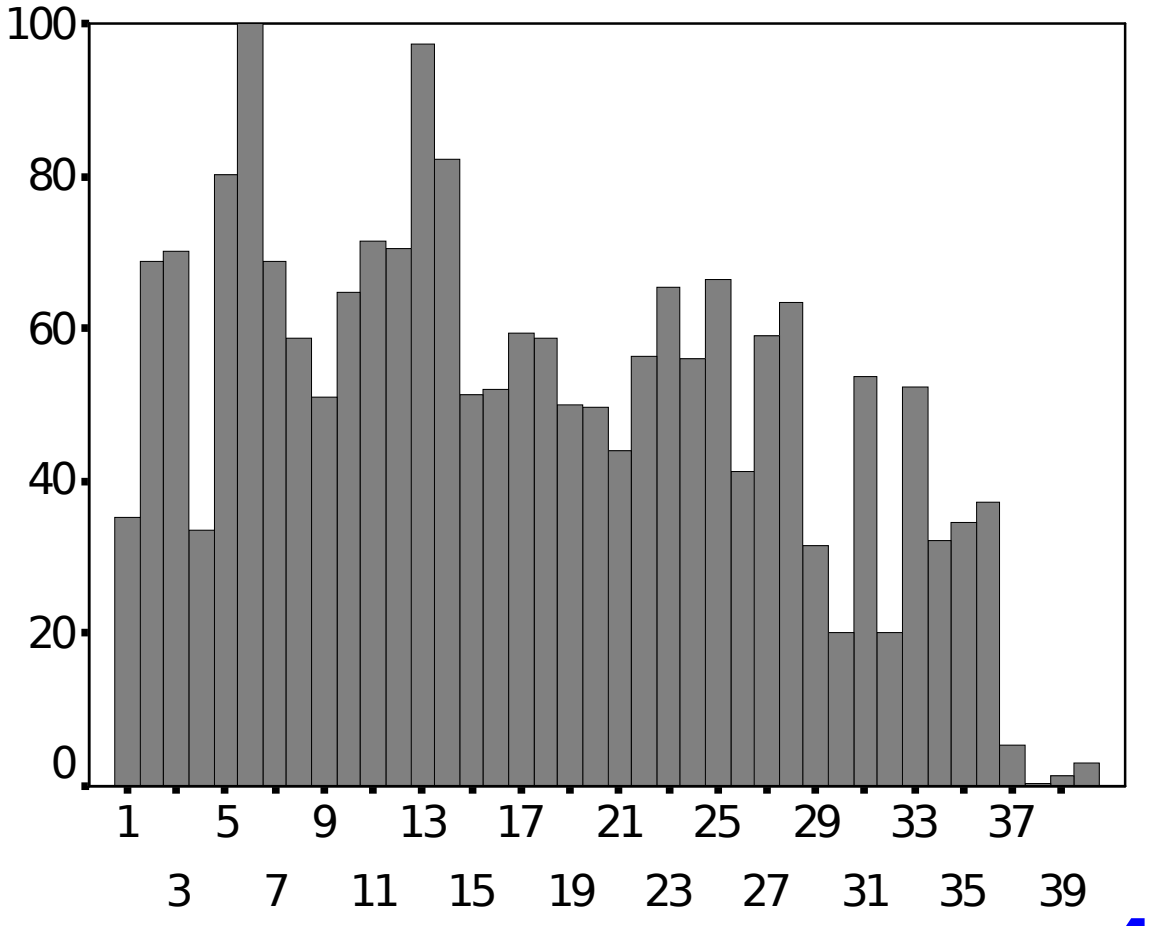
31 Sites

Canopy Cover



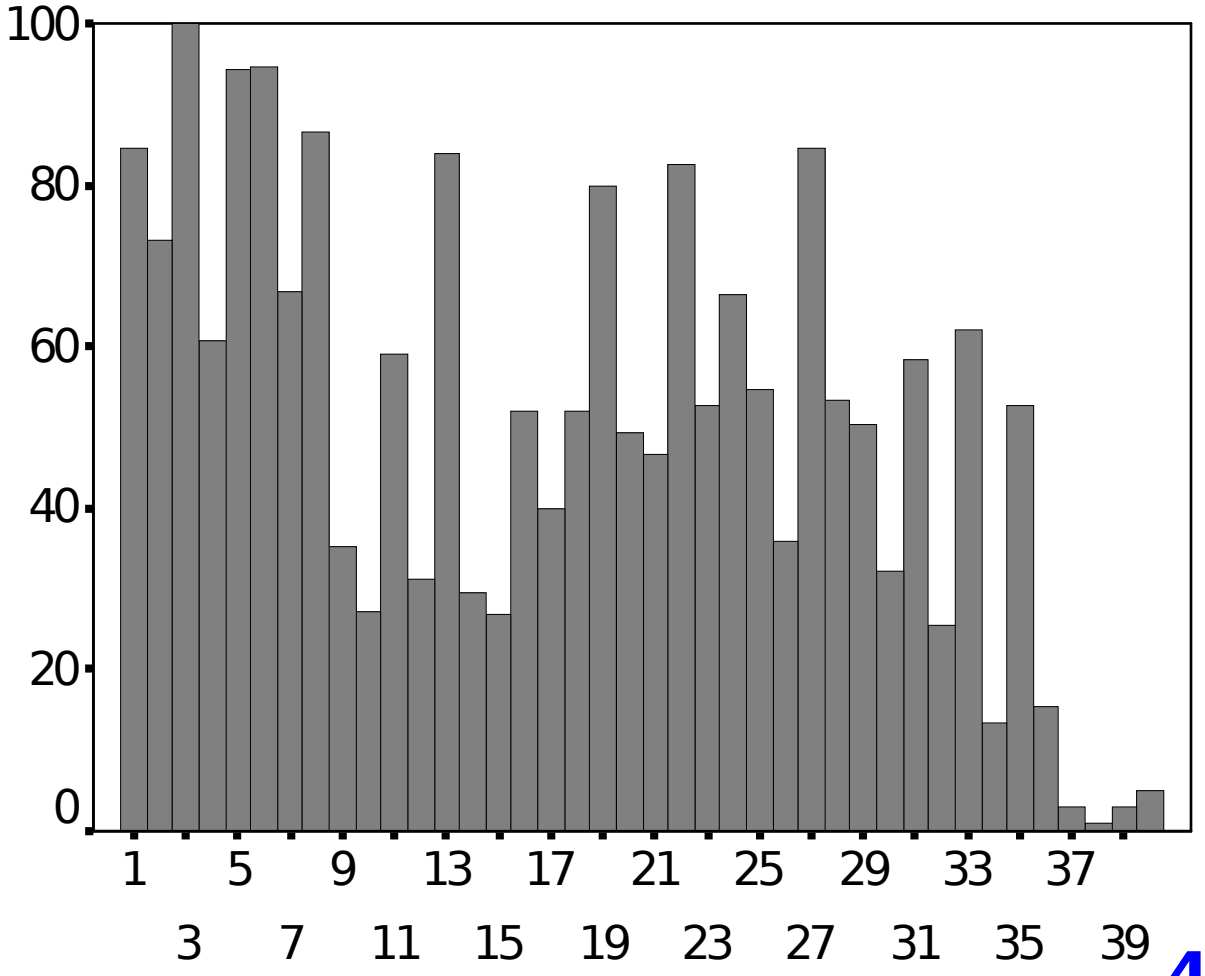
36 Sites

Basal Area



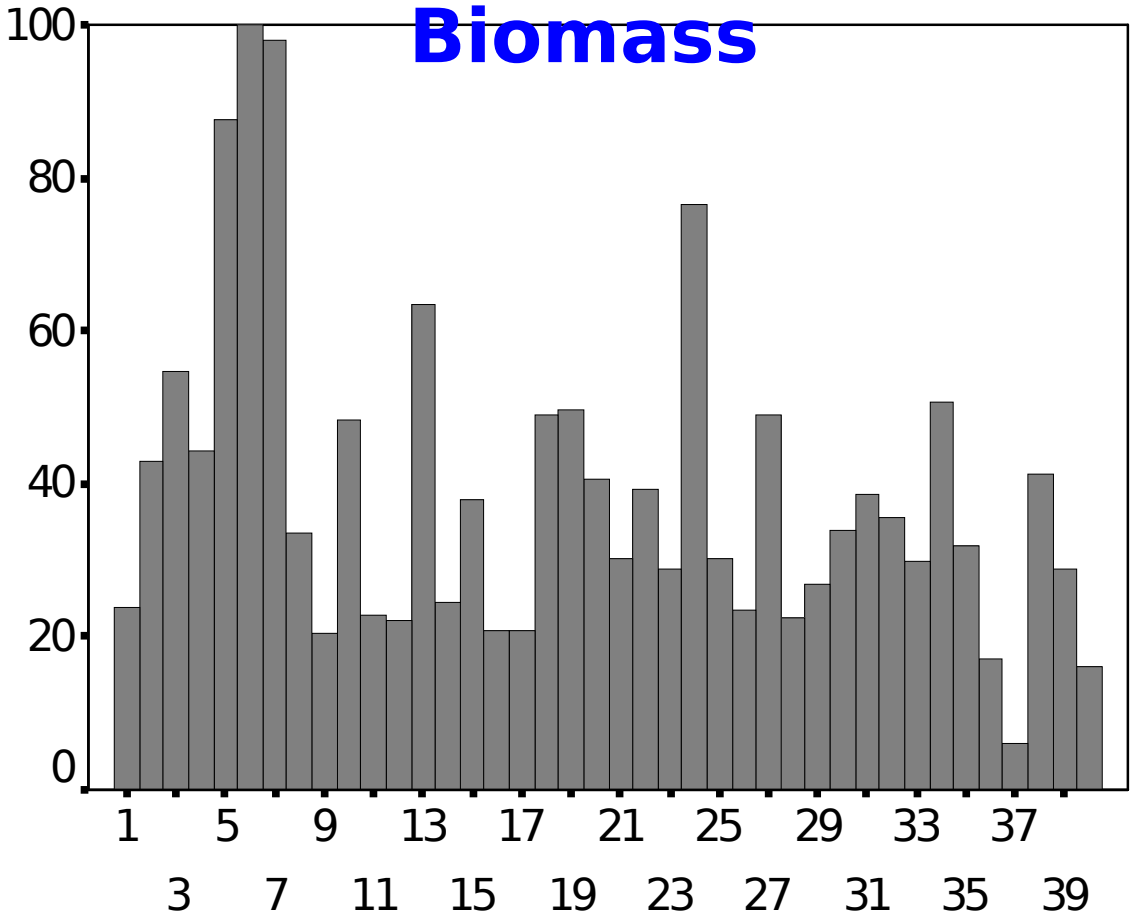
40 Sites

Tree Density



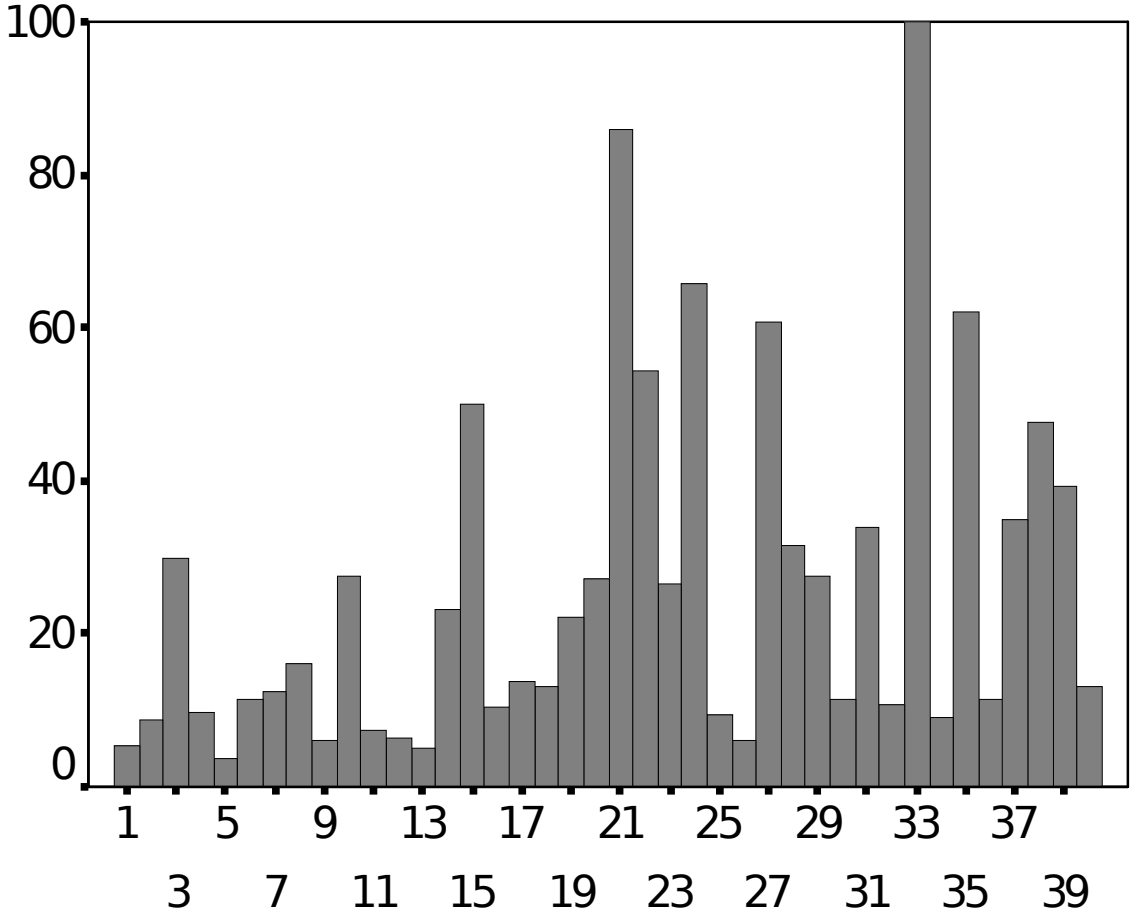
40 Sites

Microbial Biomass



40 Sites

NH_4/NO_3



40 Sites

Development Process
(Aquatic Application)

- Team Leaders asked to propose parameters
- Initial response was sparse
- Additional response requested
- Several new sets have now been proposed (many of them at the October 2003 TAC meeting)
- Some patterns of agreement emerging
- Team Leader-Research Coordinator conference call proposed for later this month
- Final candidate list to be proposed NLT 30 Oct 03
- Planned ranking of items similar to terrestrial index process Dec 03 – Feb 04

Some Proposed Aquatic Measures

- Suspended Sediments
- Number of EPT taxa
  - (or adaptations)
- Dissolved Oxygen
- Stream Bed OM
- pH
- C concentration
- TSS
- N concentration
- Conductivity
- Fish spp richness
- Georgia Index
- NC Index
- Storm runoff flux
- P concentration
- Periphyton richness

What's Next? (Oct 03)

- ✓Complete sample collection
- ✓Reduce data on hand
- ✓Complete full set for other elements
- ✓Review results for credibility
- ✓Add other elements as completed
  - Data reduction continuing
- ✓Report findings to Advisory Committee
- Test results at other locations
  - Across Sandhills in similar settings
  - At other installations in southeast
- Possible modification for other systems and regions